Bulletin 98.2 English summary.
Note my email address has changed to a temporary one.
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Contents of the May 1998 Bulletin, nr. 66.

01 "A word of the president, at the 20th anniversary" W. Coenen
A youth of twenty- the Sundial Society. Founded 11 March 1978, the Society now has sister organisations in many countries. Mr. Coenen regrets that quite a number of prominent figures of the early years have since passed away. - This anniversary will be celebrated with a public photo contest, which will be widely advertised in the media; and a festive meeting. Our summer excursion is to the new Genk sundial park.

02 "The january and march meetings and the Annual meeting" Secretariaat
Arbeitskreis Sonnenuhren meeting; an idea for dials in the century old Ruurlo Maze; Genk Sundial park and an invitation; slotted sphere dial; a CD as dial; Ton Bron acquired an equation-corrected sundial by Martin Bernhardt.20 years Zonnewijzerkring, photo contest, 10 October 1998 meeting. A slate dial in Oss, mr. Heiligenberg investigates the design. Plus many items described elsewhere in the Bulletin.

04 "Invitation for the unveiling of a new dial in Oosterbeek" Secretariaat
The dial by Boudewijn and Annie Mijwaard remains a secret until 13 June.

Lustrum celebration on Saturday 10 October 1998
For your diary: the lustrum celebration will take place on Saturday October 10th. More details will be found in the September issue of the Bulletin. There will be no meeting on September 19.

04 "Members" Secretariaat
Note changed address of (Dutch) national contact committee for the protection of monuments.

05 "Photo competition on the occasion of our fourth lustrum" Secretariaat
A public photo contest, open to every amateur, no professionals. Subject: Sun, time, shadow. Entrants should aim at suggesting the relation between sun, shadow and time, without direct reference to sundials. Open until the autumnal equinox.

06 "From the treasury" Penningmeester

07 "A new proof of Pythagoras' Theorem" J.A.F. de Rijk
The author uses the "chords theorem", which states that two chords in a circle intersect each other so that the product of the two sections of the one equals the product of those of the other. A right-angled triangle is constructed so that its hypothenuse c is the diameter of the circle. One of the other sides, a, is a chord [from this fact alone the triangle is rectangular, see Thales]. The second chord divides the first in two equal parts and is orthogonal to it. Referring to the figure, from the chords theorem we get $\frac{1}{2}a \cdot \frac{1}{2}a = (\frac{1}{2}c+\frac{1}{2}b)(\frac{1}{2}c-\frac{1}{2}b)$, or $\frac{1}{4}a^2 = \frac{1}{4}c^2 - \frac{1}{4}bc + \frac{1}{4}bc - \frac{1}{4}b^2$, or $\frac{1}{4}a^2 + \frac{1}{4}b^2 = \frac{1}{4}c^2$, and finally $a^2 + b^2 = c^2$. QED.

08 "The Roman Surveyor's Problem" J.A.F. de Rijk
As early as 1982 the author drew attention to a highly ingenious orientation method, attributed to Roman surveyors. Two years later he offered proofs by Th. de Vries and H. Janssen. By the end of 1997 the problem resurfaced as Ton vd Beld circulated a solution, unaware of the earlier exposure. The author took up renewed interest in the case. What, then, is this method?
At three arbitrary times on an arbitrary day we record on the ground the shadow of one certain point. This will be all the data we start with.
From this we can find the East-West line, the Equator plane and, from that, the altitude of the pole, i.e. the latitude. And because we may now construct an equatorial sundial and orient it correctly, we also know, in retrospect, the times (in local apparent time) of the three observations. This striking fact incited the author to find a proof easy to understand for many.
As an aside he mentions Vitruvius' method. Then follows a description of the three-shadowpoint method: In figure 2, a gnomon FS is erected. At three different times, the shadow of S is recorded on the ground. Let this be in points A, B and C. Assuming C to be closest to the foot of the gnomon F, we measure the distance SC from S towards A and B, so obtaining C' and C". L and M are vertical projections on the ground of C' and C". LM and AB intersect in

point E. Then CE is the local East-West direction! The whole procedure can be carried out with pegs and strings, and no calculations are necessary.

The proof is divided into two parts. First the geometrical problem (refer to figure 3):

Suppose we have a plane H and a point A in it. Above the plane two arbitrary points B and C "float". Call the plane through A, B and C plane E. Find the intersection of planes H and E. Solution (fig. 4): drop perpendiculars from B and C on H, giving B' and C'. Lines BC and B'C' intersect in point S. The line through A and S is the intersection of planes H and E. With this, we move on to the astronomical problem:

Notice first that a cone, its apex in the centre of a sphere, intersects this sphere along a circle (fig. 5). Fig. 6 represents the celestial sphere with polar axis, horizon and the Sun's summer path, parallel to the equator. The Sun's rays describe a cone with its top in the center of the sphere. Let the center coincide with the top of the gnomon T in fig. 7. The shadow of this top, A, is on the other half of the cone, and therefore also on a circle parallel to the equator.

Through A we place a horizontal plane H (not drawn). For two other sun positions, we find points B and C floating over plane H (not drawn either). The clever part of our method is that we actually find these points by measuring off TB and TC, equal to TA, from T. Now A, B and C are on a circle parallel to the equator plane and so we are back to the geometrical problem: construct plane E through A, B and C, and its intersection with H. Because E is parallel with the equator, the intersection runs East-West.

As a matter of interest, the intersection between the actual cone and the horizontal plane, which in the course of the year assumes different hyperbolic shapes, is not used at all.

The equatorial plane thus defined intersects the horizontal plane along an east-west line, but does not go through the top of the gnomon. B and C are in the plane, and because their positions in space are marked, we can find the equator plane by placing a board, or a piece of cardboard, on the east-west line and leaning it against point B and/or C. And so the equator plane is established materially.

11 "Rectification: the reflective cycloidal sundial is not linear" A. van den Beld

In Bulletin 97.2 this author wrote that in this dial (from a book by R. Ball), the caustic top lies on the straight line connecting the end points of the cycloid; moreover, that its position on this line is a linear function of the Sun's hour angle. A small model seemed to prove this, although when the sunlight came in far from the middle, the caustic seemed to deviate from the line. At first the author thought the shape of his cycloid mirror was not good enough. But the idea is basically incorrect, as was also pointed out in a letter the author received from C.M. Lowne. The defect is shown using two figures and some mathematical reasoning. At the end a remark by Lowne is repeated (see text). The author feels the cycloid dial has lost its charm.

14 "Central projection dials for legal time" F.J. de Vries

There are many sundial designs which use a moveable gnomon, and we find a detailed description of this class in Samuel Foster's book, as early as 1654. All these designs can be reduced to parallel projections of the universal equatorial ring dial (fig. 1, from Terpstra 1953). Hans de Rijk published about this method 1981-86 and added the idea of the central projection (projection from one point). This opens up a new class of sundials (for an example see fig. 2, a combination with a normal horizontal dial).

Longitude correction in sundials is easy, but correction for the equation of time is not because it varies daily. It can normally only be done for one time, usually noon. See fig. 3 where an analemma is drawn on the date strip. Fig. 4 shows a construction by Seidelman for the Kennett Sq, Pa, dial. This practically corrects for EOT, although theoretically there remains an error. Fig. 5 (Sawyer) shows analemmatics around each hour line. The gnomon can now remain fixed.

In 1997, Yvon Masse published a central projection sundial indicating clock time, both standard and daylight saving time. An example for Utrecht is shown in fig. 6. The style is a string from the top of the gnomon to the correct date point on either the standard or the dst loop. The style is thus variable in place and direction.

Fer now goes on to explain how this central projection dial is designed. The projection point must be in the equatorial plane, so that the hour scale is a straight line. The point is also on the ring of the projected equatorial ring dial. It could be chosen in any hour point, the finished date scale will be on the hour line 180 degrees on. - For the EOT correction, refer to fig. 10. Draw a line from P through a new point Q. Yvon Masse chooses his line to be perpendicular to the hour scale, which simplifies calculations, but the line PQ is totally arbitrary, as shown in the figure. Q is just another hour point and it is now fixed. C is the center of the ring. Draw a diameter through the middle of chord PQ. Draw QC, and then QC' so that angle C'QC is the EOT expressed in angular measure. Now a new ring is drawn through P and Q with C' as its center. The new ring has a different radius and P is now a different hour point on it. The date line on the pole style is now moved from C to C' and has different dimensions. The one relevant point of the date line is now projected from P onto the dial surface. After enough repetitions for various dates and EOTs we have the date scale in the form of the loops in fig. 6. This construction has no influence on the hour scale. Some examples of this fact are shown in fig. 10. - Daylight saving time: we could renumber the hour scale with numerals one higher, but a more elegant solution is to calculate a new date scale on a different hour line. See fig. 6.

Yvon Masse has included a Basic computer program. Fer discovered another possibility. He noticed that the loop for 52 N looked a lot like an "ordinary" loop on an "ordinary" horizontal dial for 52 South. The following holds: If you use a program or routine to draw horizontal dials, you can draw an Yvon Masse loop if you change the sign for latitude, use the same value for inclination, use declination plus 180 degrees, and change the sign for the hour line. Fer illustrates this in fig 11. Left is Masse's, right is his, middle is both.

21 "Origami sundials" (from BSS bulletin 97.4) F.J. de Vries

Take an equatorial sundial and notice that the equator disk casts a shadow on the pole style. The shadow indicates the date. John Moir exploits this idea. In fig. 2 he uses a cone. In fig. 3 the cone has a bigger top angle and a piece cut off the bottom to correct for that. Now it will not roll away. In fig. 4 the pole style is made out of a piece of paper, fig. 5 shows how. Now a neat trick: John Moir chooses his variables so that the two pieces of paper can be replaced by just one piece, folded instead of glued.

When Fer checked the design logic, he found that this is only possible for quite a limited range of latitudes: from about 47.5 to about 52.5 degrees (south or north). Moir also mentioned this in the 98.1 BSS bulletin.

23 "Spreadsheet Sundial design" H. Sassenburg

The author introduces the spreadsheet, comparing it to the old-day programmable calculator but with bells and whistles. Then he proposes the following steps to arrive at the design: 1) general data, names of variables etc. ; 2) calculation of declination (approximated by a sine function) and equation of time (approximated by a sine function and the second harmonic, accurate to -34 to +30 seconds); 3) calculation of hour angle; 4) calculation of coordinates X, Y, Z from hour angle and declination; 5) correction for latitude using a rotation around the x-axis by 90-lat); 6) correction for east or west declination of the plane using a rotation around the z-axis by that amount); 7) correction for inclination of the plane using a rotation around the x-axis by that amount); 8) calculation of shadow point x, y. - Why use a spreadsheet? The author names 3 benefits: he has learned to sort out and use all the many formulae, the steps to arrive at the result are easy to follow, and the effects of the various parameters are easy to see. The sheet runs under Excel, and is available from the author for the asking. He will gladly send it by mail or by E-mail.

29 "The Excellent Greek sundial of Leyden" J. Kragten

The author investigates into the quality of the workmanship. He starts with a discussion of his methods. These dials consist of a conical surface cut out of stone; a point shadow is read to tell (temporal hour-) time. The winter, equinox, and summer arcs are drawn in, but the seven zodiacal arcs are not. Now the author notes that the shape of the cone surface is independent of the location for which the dial is made. The cone's position with regard to the horizontal plane does depend on the location. The angle between the cone's axis and the horizon equals the latitude, but this cannot be measured directly. We only have the angles between the actual surfaces, the distance to the arcs, and the arc lengths to work with. In fig. 3, the author prefers angle alpha, this being a direct function of the latitude.

The arc lengths are not dependable upon, because the latitude is a very sensitive function of it. An error in length of a quarter of a millimeter (10 mil) changes the calculated latitude by two degrees. In the opinion of the author, mrs. Gibbs does not do a very good job of analysing her specimens- she does not find phi.

The actual Leyden dial is now discussed. Measurements are in fig. 5. Angle alpha gives a latitude of 37, slightly south of Athens where the dial was found. The date arcs are perfectly circular and perpendicular to the cone's axis. The hour lines divide the arcs in twelve quite regularly, except the 9 hour line which strays for over a millimeter (40 mil)- a human error. A table lists actual and calculated measurements. The author concludes that the stonemason was a sundial professional.

34 "Local apparent time or legal time?" J. Kragten

An invitation to discuss the relative merits of both hour line systems. The location and intended use of a particular sundial may dictate the lines used. The author distinguishes:

1. Historical: (restored) dials from the period when LAT was used should presumably retain their LAT hour lines. 2. Private dials: whatever suits you, no discussion will ever arise. 3. New dials for public use. a. When LAT lines are used, many people will think the sundial is no good at all. In our country the dial will be off by over one and a half hour in summer. b. Legal time. It would be a good idea to correct for longitude directly in the hour line pattern. With regard to daylight saving time: we have dst for two months longer than standard time. Besides a sundial works longer per day in summer. Therefore hour lines in daylight saving time would be the best choice. Should dst ever be abandoned, only the numerals would have to be moved. c. Equation of time: I. No real necessity here. It is never more than six minutes in summer. In winter the sundial gets little attention; II. Or we can use a construction that will give exact legal (clock) time without any correction being necessary (see photo). d. A combination. This could be a good idea but care should be taken that the dial face does not become too crowded.

In the Rupelmonde dial park all the sundials show local apparent time. A "simple" correction will give clock time. An example of such a simple correction is given.
Hans de Rijk, Fer de Vries agree. So does Ton vd Beld. He can see why Rupelmonde is what it is, but admits he always forgets if he should be adding or subtracting EOT. Dees Verschuuren explains what induces him to use LAT or legal hours, as the case may be, in his designs. Finally Wiel Coenen tries to look at a sundial through the layman's eyes. He can see the problem, is inclined to solution 3d., and then concludes with the observation that whatever the public's view, it will not harm the true gnomonist.

39 "Another meridian determination" J. Schepman
Teletext page 718 gives, among other things, the time of the meridian passage of the sun. Use of the card, or two posts in the garden, will enable one to find the north-south line easily.

40 "A polar dial cut-out for both hemispheres" J. Schepman
The author advises us to copy the design on thin cardboard, stick it together and dash off to Australia, Africa or South America to check it out.

41 "So what, exactly, is an isoclinic dial?" A. van der Hoeven
After having erroneously called a design of his "isoclinic", the author sets out to investigate what exactly does constitute an isoclinic dial. The term is not used by Rohr, Waugh, or Mayall at all. The encyclopedia gives a definition, but this is not applicable to dialing. The author goes back to the original JRASC article where the term was first used. Then follows a discussion of the various types that fulfill the requirements. In conclusion we see that all polar designs should be called isoclinic. This being the case, the term is rather meaningless and should perhaps not be used. And as we have seen in the other literature, it is not.

45 "Sundials in the Netherlands" W. Coenen
The Eise Eisinga Planetarium (constructed from 1774 to 1781) was reopened 11 March after its restauration. The Royal Commissioner, mr. Hermans, did the honours. A number of Sundial Society members were present. The positioning of the Sun could be watched on a video screen in the hall.
In Oosterwolde mr. Kaptein constructed a sundial in tiffany (pieces of coloured glass) (see photo). - Bloemendaal 2' is a new 2 meter (6'6") square vertical sundial by mr. Van Rhijn and mr. Damave. It shows 5-13 MET and has a "XII" on the meridian. - Hillegom, open air swimming pool De Vosse' has a sundial in the walking area between two basins. The style (a bent flagpole) is placed wrong. But, according to the manager, the time indication (in MEST) is "fair" in summer. - Molenaarsgraaf. Our member mr. Borsje received a horizontal dial made of lead. Measurements and inscriptions are given. Who knows more about its origin? - Schoonhoven 1' will be repainted using the drawings of mr. Vd. Wijck (see 96.1 p.38). - Oss, an archeological find of a slate sundial fragment, est. 14th or 15th century. The Society was promised a photo or rubbing of the fragment.

49 Literature 1285 t/m 1298 D. Verschuuren
Many, many references. Roman dodecahedrons feature in two lemmas. One amateur archaeologist thinks they could have been used as a form of calendar [sowing time, etc.; farmers in remote districts wished to be independent of formal Roman legal systems]. The Tongeren Gallo-Romanic Museum lists 77 dodecahedrons with measurements and sites in a well documented book. Several speculations as to their possible use. But the calendar is not mentioned.